

Selected “Combined Experiment” and “Unsteady Aerodynamics Experiment” Publications

(through January 2000)

1. Journal and Conference Publications

(Authored by NREL Unsteady Aerodynamics project staff, students, and subcontractors)

Schreck, S., Robinson, M. C., Hand, M. M., Simms, D. A., “HAWT Dynamic Stall Response Asymmetries Under Yawed Flow Conditions”, AIAA-2000-0040, Prepared for the 38th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 10-13, 2000, p. 183-196.

Xu, G., Sankar, L. N., “Effects of Transition, Turbulence, and Yaw on the Performance of Horizontal Axis Wind Turbines”, AIAA-2000-0048, Prepared for the 38th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 10-13, 2000, p. 259-265.

Duque, E. P. N.; van Dam, C. P.; Hughes, S. C., “Navier- Stokes Simulations of the NREL Combined Experiment Phase II Rotor”, AIAA-99-0037, Prepared for the 37th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 11-14, 1999, p. 143-153.

Whale, J.; Fisichella, C. J.; Selig, M. S., “Correcting Inflow Measurements from HAWTS Using a Lifting-Surface Code” AIAA-99-0040, Prepared for the 37th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 11-14, 1999, p. 175-185.

Xu, G.; Sankar, L. N., “Computational Study of Horizontal Axis Wind Turbines”, AIAA-99-0042, Prepared for the 37th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 11-14, 1999, p. 192-199.

Acker, T.; Hand, M., “Aerodynamic Performance of the NREL Unsteady Aerodynamics Experiment (Phase IV) Twisted Rotor”, AIAA-99-0045, Prepared for the 37th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 11-14, 1999, p. 211-221.

Du, Z. and Selig, M. S., “A 3-D Stall-Delay Model for Horizontal Axis Wind Turbine Performance Prediction”, Prepared for the 36th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 12-15, 1998, p. 9-19

Freeman, J. B.; Robinson, M. C., “Algorithm Using Spherical Coordinates to Calculate Dynamic Pressure from 5-Hole Pressure Probe Data”, Prepared for the 36th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 12-15, 1998, p. 70-74.

Tangler, J. T., Selig, M. S., “An Evaluation of an Empirical Model for Stall Delay Due to Rotation for HAWTs”, Prepared for the American Wind Energy Association Windpower ’97 Conference and Exhibition, June 15-18, 1997, Austin TX, p 87-96.

Huyer, S. A.; Simms, D.; Robinson, M. C., “Unsteady Aerodynamics Associated with a Horizontal-Axis Wind Turbine”, AIAA Journal. Vol. 34, Number 7, July 1996, pp. 1410-1419.

Simms, D.A.; Robinson, M. C.; Hand, M.M.; Fingersh, L.J., “Characterization and Comparison of Baseline Aerodynamic Performance of Optimally-Twisted Versus Non-Twisted HAWT Blades”, NREL/ TP-442-2028, Prepared for the Fifteenth ASME Wind Energy Symposium, 29 January - 2 February 1996, Houston, TX., p 143-148.

Robinson, M. C., Galbraith, R. A. McD., Shipley, D. E., and Miller, M. S., “Unsteady Aerodynamics of Wind Turbines”, AIAA 95-0526, Prepared for the 33rd Aerospace Sciences Meeting and Exhibit, January 9-12, 1995, Reno, NV.

Shipley, D. E.; Miller, M. S.; Robinson, M. C., ”Dynamic Stall Occurrence on a Horizontal Axis Wind Turbine Blade”, Prepared for the ASME/ ETCE Conference, January 29 - February 1 1995, Houston, TX, p. 167-173.

Simms, D. A., Fingersh, L. J., Butterfield, C. P., “NREL Unsteady Aerodynamics Experiment Phase III Test Objectives and Preliminary Results”, Prepared for the ASME/ ETCE Conference, January 29 - February 1 1995, Houston, TX, p. 273-275.

Fingersh, L. J., Simms, D. A., Butterfield, C. P., Jenks, M. D., “An Overview of the Unsteady Aerodynamics Phase III Data Acquisition System and Instrumentation”, Prepared for the ASME/ ETCE Conference, January 29 - February 1 1995, Houston, TX, p. 277-280.

Simms, D. A., ”Full-Scale Wind Turbine Rotor Aerodynamics Research at the National Renewable Energy Laboratory, NREL/TP-441-7225, Presented at the European Wind Energy Conference, October 10-14, 1994.

Shipley, D. E.; Miller, M. S.; Robinson, M. C.; Luttges, M. W.; and Simms, D. A.; "Evidence that Aerodynamic Effects, Including Dynamic Stall, Dictate HAWT Structural Loads and Power Generation in Highly Transient Time Frames", NREL/TP-441-7080, Prepared for the Windpower '94 Conference, Minneapolis, MG, May 9-13, 1994.

Robinson, M. C.; Luttges, M. W.; Miller, M. S.; Shipley, D. E.; Young, T. S., and Simms, D. A., "Wind Turbine Blade Aerodynamics: The Analysis of Field Test Data", presented at the 13th ASME/ ETCE Wind Energy Symposium, New Orleans, LA, January 23-26, 1994, NREL/TP-441-7108.

Simms, D. A., Butterfield, C. P., "International Collaborative Research in Wind Turbine Rotor Aerodynamics", NREL/ TP-441-5810, Prepared for the ASME ETCE Wind Energy Symposium, January 23-26, 1994.

Hansen, A. C.; Butterfield, C. P., "Aerodynamics of Horizontal-Axis Wind Turbines", Annual Review of Fluid Mechanics. Vol. 25, 1993, pp. 115-149.

Robinson, M. C.; Luttges, M. W.; Miller, M. S.; Shipley, D. E.; Young, T. S., and Simms, D. A., "Wind Turbine Blade Aerodynamics: The Combined Experiment", presented at the Windpower '93 Conference, San Francisco, CA, July 12-16, 1993, NREL/TP-441-7107.

Huyer, S. A., Butterfield, C. P., Simms, D. A., "Characterization of Dynamic Stall Phenomena on Wind Turbine Blades Using Surface Pressure Measurements", Prepared for the 11th ASME Wind Energy Symposium, January 26-29, 1992, ASME, p. 45-46.

Huyer, S. A., Simms, D. A., Butterfield, C. P., "Dynamic Stall on Wind Turbine Blades", Prepared for the 11th ASME Wind Energy Symposium, January 26-29, 1992, p. 47-48.

Butterfield, C. P., Huyer, S. A., Simms, D. A., "Recent Results from Data Analysis of Dynamic Stall on Wind Turbine Blades", NREL/TP-257-4654, Prepared for the International Energy Agency Experts Meeting on Wind Turbine Aerodynamics, Stuttgart, Germany, December 3-4, 1991.

Simms, D. A., Butterfield, C. P., "A Comparison of Spanwise Aerodynamic Loads Estimated from Measured Bending Moments Versus Direct Pressure Measurements on Horizontal Axis Wind Turbine Blades", NREL/TP-257-4507, Prepared for the Windpower '91 Conference and Exposition, Palm Springs, California, September 24-27, 1991, pp. 146-154.

Butterfield, C. P., Hansen, A. C., Simms, D. A., Scott, G., "Dynamic Stall on Wind Turbine Blades", Presented at Windpower '91 Conference and Exposition, Palm Springs, California, September 24-27, 1991, pp. 132-138.

Butterfield, C. P.; Nelsen, E. N., "Aerodynamic Testing of a Rotating Wind Turbine Blade", Prepared for Solar '89, NREL/ TP-217-3490, Denver, Colorado, 19-22 June 1989. 7 pp.

Butterfield, C. P., "Aerodynamic Pressure and Flow-Visualization Measurement from a Rotating Wind Turbine Blade", NREL/TP-217-3433, Prepared for the Eighth ASME Wind Energy Symposium, Houston, Texas, 22-25 January 1989, 11 pp.

Butterfield, C. P., "SERI 'Pilot' Aerodynamics Experiment", Prepared for the Seventh ASME Wind Energy Symposium; Eleventh Annual Energy-Sources Technology Conference and Exhibition; New Orleans, Louisiana; January 10-13, 1988. SED-Vol. 5, The American Society of Mechanical Engineers, p. 89.

2. NREL Technical Publications

(Authored by NREL Unsteady Aerodynamics project staff, students, and subcontractors)

Simms, D.; Schreck, S.; Hand, M.; Fingersh, L.; Cotrell, J.; Pierce, K.; Robinson, M.; "Plans for Testing the NREL Unsteady Aerodynamics Experiment 10-m Diameter HAWT in the NASA Ames Wind Tunnel", NREL/TP-500-27599, October 1999.

Simms, D.A.; Hand, M.M.; Fingersh, L.J., Jager, D. W., "Unsteady Aerodynamics Experiment Phases II-IV Test Configurations and Available Data Campaigns", NREL/ TP-500-25950, July 1999.

Giguere, P. and Selig, M. S., "Design of a Tapered and Twisted Blade for the NREL Combined Experiment Rotor", NREL/SR-500-26173, Department of Aeronautical and Astronautical Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois, April 1999.

Miller, M. S.; Shipley, D. E.; Young, T. S.; Robinson, M. C.; Luttges, M. W.; and Simms, D. A., "Combined Experiment Phase II Data Characterization", NREL/TP-442-6916, November 1995.

Miller, M. S.; Shipley, D. E.; Young, T. S.; Robinson, M. C.; Luttges, M. W.; and Simms, D. A., "The Baseline Data Sets for Phase II of the Combined Experiment", NREL/TP-442-6915, July 1995.

Miller, M. S.; Shipley, D. E.; Robinson, M. C.; Luttges, M. W.; and Simms, D. A.; "Determination of the Reliability of the Combined Experiment Data", NREL/TP-442-6914.

Shipley, D. E.; Miller, M. S.; Robinson, M. C.; Luttges, M. W.; and Simms, D. A.; "Techniques for the Determination of Local Dynamic Pressure and Angle of Attack on a Horizontal Axis Wind Turbine", NREL/TP-442-7393, May 1995.

Butterfield, C. P., Musial, W. P., Simms, D. A., "Combined Experiment Final Report - Phase I", NREL/TP-257-4655, May 1992

Butterfield, C. P., Musial, W. P., Simms, D. A., "Combined Experiment Final Report - Phase II", NREL/TP-442-4807, May 1992

Huyer, S. A. "Examination of Forced Unsteady Separated Flow Fields on a Rotating Wind Turbine Blade", NREL/TP-442-4864, May 1992

Simms, D. A., "Unsteady Aero Experiment Test Plan", NREL/TP-257-4656, August 1991.

3. Other Selected Publications Utilizing Combined/ Unsteady Aerodynamics Experiment Data

Masson, C., Smaili, A., Ammara, I., Leclerc, C., "Aerodynamic Investigations on Tower-Shadow Impacts for HAWTs", AIAA-2000-0041, Prepared for the 38th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 10-13, 2000, p. 208-218.

Munduate, X., Coton, F. N., "Identification of Dynamic Stall Regions on Horizontal Axis Wind Turbines", AIAA-2000-0039, Prepared for the 38th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 10-13, 2000, p. 172-182.

Sorensen, N. N., Michelsen, J. A., "Aerodynamic Predictions for the Unsteady Aerodynamics Experiment Phase II Rotor at the National Renewable Energy Laboratory", AIAA-2000-0037, Prepared for the 38th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 10-13, 2000, p. 161-171.

Leclerc, C.; Masson, C., "Predictions of Aerodynamic Performance and Loads of HAWTS Operating in Unsteady Conditions", AIAA-99-0066, Prepared for the 37th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 11-14, 1999, p. 335-345.

Madsen, P. H.; Pierce, K.; Buhl, M., "Predicting Ultimate Loads for Wind Turbines", AIAA-99-0069, Prepared for the 37th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 11-14, 1999, p. 355-364.

Madsen, H. A.; Petersen, J. T.; Bruining, A.; Brand, A.; Graham, M., "Field Rotor Measurements Data Sets Prepared for Analysis of Stall Hysteresis", Risø-R-1046(EN), Risø National Laboratory, Roskilde, Denmark, May 1998.

Wang, T., Coton, F. N., Galbraith, R. A., "An Examination of Two Tower-Shadow Modelling Strategies for Downwind Wind Turbines", Presented at the 36th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 12-15, 1998, p. 20-30.

Schepers, J. F.; Brand, A. J.; Bruining, A.; Graham, J. M. R.; Hand, M. M.; Infield, D. G.; Madsen, H. A.; Paynter, R. J.; Simms D. A.; "Final Report of IEA Annex XIV: Field Rotor Aerodynamics", ECN-C-97-027, June 1997, Netherlands Energy Research Foundation, Petten, The Netherlands.

Coton, F. N., Wang, T., Galbraith, R. A., "A Fully Unsteady Prescribed Wake Model For HAWT Performance Prediction in Yawed Flow", Prepared for the American Wind Energy Association Windpower '97 Conference and Exhibition, June 15-18, 1997, Austin TX, p 55-64.

Hansen, A. C., Laino, D. J., "Validation Study for AERODYN and YAWDYN Using Phase III Combined Experiment Data", AIAA-97-0943, Prepared for the 1997 ASME Wind Energy Symposium 35th Aerospace Sciences Meeting and Exhibit, January 6-9, 1997, Reno NV.

Borg, J. P., Kirchoff, R., "The Effect of Aerodynamic Imbalance on a Horizontal Axis Wind Turbine", Prepared for the Fifteenth ASME Wind Energy Symposium, 29 January - 2 February 1996, Houston, TX., p 143-148.

Slepiski, J. E., Kirchoff, R. H., "The Analysis of Unsteady Wind Turbine Data Using Wavelet Techniques", Prepared for the ASME/ETCE Conference, January 29 - February 1 1995, Houston, TX, p. 227-235.

Slepiski, J. E., Kirchoff, R. H. "An Investigation of Stall on a Rotating Wind Turbine Blade", presented at the 13th ASME/ ETCE Wind Energy Symposium, New Orleans, LA, January 23-26, 1994, p. 17-25.

Miller, M. S., Shipley, D. E., "Structural Effects of Unsteady Aerodynamic Forces on Horizontal-Axis Wind Turbines", Prepared for the AIAA Student Conference, St. Louis, MO. April 18, 1992.

Eggers, A. J. Jr. and Digumarthi, R. V., "Approximate Scaling of Rotational Effects on Mean Aerodynamic Moments and Power Generated by the Combined Experiment Rotor Blades Operating in Deep-Stalled Flow", Presented at 11th ASME Wind Energy Symposium, January 26-29, 1992, ASME, p. 33-43.

Schnepp, R. R., Hansen, A. C, and Wright, A. D., "A Method for Determining Aerodynamic Loads on a Wind Turbine From Blade Flap Bending Moments", Presented at 11th ASME Wind Energy Symposium, January 26-29, 1992, ASME, p. 83-88.